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Depth estimate of the magnetic basement by thermomagnetic modeling of Provincia magmática do Paraná-Etendeka

Fernando Rocha (Universidade Rural do Rio de Janeiro), Suze Guimaraes (Universidade Rural do Rio de Janeiro)

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Introduction

The crystalline/metamorphic basement and the sediment coverage both have different origins, tectonic history, lithologies and magnetic properties. These differences results in different geometries of magnetic sources associated with faults, fracture zones, igneous intrusions, erosive truncations, sub crop borders and other structural discontinuities. The magnetic sources that resemble each other both in age and geological history, in general, are grouped up in crustal provinces and their boundaries can be highlighted by tectonic events like the ones cited before. Studying the thermal structure of the crust while characterizing the lithospheric magnetization limits permits exploratory potential be known. This study presents shows the depth of the magnetic basement by thermomagnetic modeling in Província magmática of Paraná-Etendeka (Paleozoic/Mesozoic), a province that involves the Formação Serra Geral, in Bacia do Paraná that extends since the region Centro-Sul of Brasil to the limits of Paraguai, Uruguai and Argentina.

Method and/or Theory

The thermomagnetic model utilizes a combination of direct data of depth temperature and spectral analysis of aeromagnetic data to estimate a Curie isotherm depth and crustal magnetic basement. The Curie surface is an isothermal limit in which magnetic minerals lose their magnetization outlining an isotherm of around 580°C. The objective is to examine the variation in thermic fields within the Earth's surface. In the lithospheric region, the heat transmission is done by conduction, as the physical characteristics of the crust extends until the upper mantle

Correlating the geothermic data and crustal magnetic modeling can produce information about the depth temperature and magnetic petrology. Both geothermic parameters related to rocks are used in unidimensional crustal thermic modeling. In a stable regime of heat exchanges by conduction, these parameters are: the thermal conductivity (λ) and the production of radiogenic heat (A) in the upper layers of the crust. The TERMOMAG model concentrates in investigating the magnetizable limits of the crust using the Curie Isotherm and realizing a cross-check of the results of the Curie depth obtained by the geothermic modeling of the crust and the spectral analysis of the aeromagnetic data.

This verification establishes a correction factor denominated "Thermomagnetic factor". Its bases are founded by the differences in the empiric data results and the theoretical models (double check), for better estimated values of the Curie Isotherm, taking into consideration the geotectonic context of the analyzed region. The correction factor (β) calculated for the tectonic context is applied to estimates of the Curie surface, minimizing the uncertainties of the associated indirect methodology

Results and Conclusions

The results obtained permits identification of the limit of the magnetized crust being part integrated of studies related to the thermic crustal behavior and supports possible hydrothermalism regions associated to mineralization of the crust and seismic studies.

Preliminary results indicate the Curie depth in the Provincia magmática Parana-Etendeka region varies between 20km to 60km with an associated error of 5km. In the Centro-Norte region of the magmatic province of Paraná there is basalt spills with Upper Jurassic ages and Inferior Cretaceous, managing to hit thickness of up to 1500m. The magnetic basement gets to 20km of depth and in this region the heat flux doesn't surpass 40mW/m²

Regions with elevated geothermic fluxes indicate a thickness for elevated magnetic basement, resulting in the mapping of the Curie surface being useful for future geothermic exploration.

Keywords: Curie Surface, magnetic basement, geotherm, spectral analysis, thermomagnetic, Província magmática Parana-Etendeka, Brasil.